Remarks by Georg A Shultz, Chief Energy Forecasting Branch, Rural Utilities Service, on March 6, 2002 at the RUS 2002 Electric Engineering Seminar in Dallas, TX on Photovoltaics.

Solar Power Opportunities

Photovoltaic system technology uses semiconducting materials to convert radiant energy into electricity. It is the only technology that converts renewable energy sunlight into electric energy directly. Hence its relative simplicity. Electricity is obtained without moving parts or emissions. PV systems are most efficient during peaking hours of sunlight are basically viewed as sun correlated peaking units. However, PV does produce electricity even under reduced light.

Photovoltaic electric generating systems are coming down in cost. The nation is on a combustion turbine building binge. What to PV systems and combustion turbines have in common? Both provide energy for about 15% of the time and usually for the same time. How are they different. PV is capital intensive and has a zero cost of fuel. Combustion turbines are relatively cheap and are fueled by natural gas which will increase in cost, has other uses and is somewhat volatile in price.

PV, like combustion turbines, are more a source of capacity than energy. But are valued as an energy source. Look at PV as capacity and PV will be a tool to reduce the capacity requirements of supplying electricity. Capacity is measured at generation, at transmission and at distribution levels. Locating a PV system at a strategic point on a distribution system can enhance the overall performance of the electric system, from the load to the generation.

A properly located and sized PV resource produces a variety of benefits. Energy is reliably produced at the time of system peak at no cost to control. This relieves the grid from load to supply without intervention as assuredly as the sun increases your load. Since PV produces power near the load, it will reduce transmission system loading and create significant transmission capacity benefits which can be as large as hundreds of dollars per kilowatt of displaced transmission loading. Furthermore, on fully loaded distribution circuits, PV can defer system upgrades. The injection of energy can also reduce peak losses on feeder and substation transformers further leveraging the benefits. When these reduced losses and the energy produced by the PV system are considered, the PV system releases more capacity than would otherwise be evident. As utilities need new generation these benefits could amount to hundreds of dollars per kilowatt of displaced peak energy production.

Feeders that are good candidates for PV installations have the following characteristics;

- Heavily loaded and due for system improvements
- Poor reliability and voltage quality in the area downstream of the installations.
- Suitable loads at the point of needed insertion.
- A daily demand cycle that matches the PV output curve.

These are the arguments for distributed generation. PV as the source of that DG brings reliability and production at the time of need. Sometime ago while talking to a GT coop engineer about the weather, specifically thunderstorms, he volunteered that he could locate where there were thunderstorms in his service territory. When I asked how, the answer was both obvious and intuitive. As the storm advances through our territory loads drop in the areas of the storm. He could tell by how much his delivery points were demanding. PV value as a peaking solution is both obvious and intuitive, but to have any impact it must be installed before it is needed.

The SMUD Example

This brings me to SMUD, the Sacramento Municipal Utility District. With over 8MW of grid connected photovoltaics on it system in over 700 installations ranging from customer rooftops to substation solar power systems, SMUD has the largest distributed PV system in the world. SMUD plans to add another 7MW by the end of 2003. This is not an accident. It is part of a concerted 10 year effort.

SMUD's mission as a customer owned utility is to meet the electric and energy service needs of its customers in a safe, reliable, economic and environmentally responsible manner. These values, similar to those of cooperative utilities, turned SMUD to look into PV as a core element of its business strategy. In 1993 SMUD embarked on a strategy it called Sustained, Orderly Development and Commercialization (SODC) of the grid connected, utility PV market. This strategy is aimed at developing experience needed to successfully integrate PV as distributed generation into the utility system, developing long term utility marketing and business strategies and to stimulate the collaborative process needed between SMUD, its customers, and PV vendors needed to accelerate the system cost reductions so that PV would be cost-competitive by the end of 2003.

There are 2 main facets of the SODC strategy. A sustained multiyear commitment to purchase a substantial number of PV systems each year at declining yearly prices. The second is growth in the development of the grid connected market and business practices to commercialize that market. The aim is to transition PV from a subsidized resource to a self sustaining, commercial resource for domestic, grid connected applications. If we step back and look at this approach objectively we will recognize that most new electric facilities are 'subsidized' before they are fully utilized.

It is the mitigation of risk, the stimulation of new production and the effects of technology improvements in the new production that creates the benefits caused by SODC. SODC must lead to structural benefits to the supplier to have lasting benefits. As production is increased the resulting price reductions become permanent and provide lasting benefit, unlike demonstration projects and one time purchases, no matter how large. Under a long term solicitation the vendor is able to expand capacity knowing that a substantial portion of the expansion is already committed. This lowers the financial risk and improves finance-ability. The expanded production will be based on new technology and production techniques. This combines to permit the vendor to provide the purchaser with lower pricing than would otherwise be possible. A yearly increasing purchasing schedule combined with a decreasing price permits a phased ramp up by the supplier and lower costs to the purchaser.

The program was conducted in 2 basic phases. The first phase 1993 to 1998 consisted of a series of yearly solicitations with purchases of 500KW to 700KW per year which built the distributed PV system to 5 MW. These installations helped lower the future cost of PV electricity by allowing SMUD to gain experience in the installation, operation, maintenance, pricing strategies, and other aspects of residential PV systems. As a result, SMUD customers are now able to buy their own PV system and use its electricity for themselves as part of the next phase.

For 1998 through 2003 SMUD entered into long term contracts for a full 10 MW of PV. This second phase will bring down the fully installed cost to below $3 per KW by 2003. At this price SMUD PV competes well with residential retail rates. The utility has also simplified interconnection standards. A new PV factory has been located in its service territory to supply the units.

For the first years SMUD installed and owned the 2 to 4 KW units. Some 600 of these units have been installed. A typical 2kW residential rooftop solar system produces up to 3,600 kW hours per year. Due to the response to the Solar Pioneer Program there is at least a 4 month waiting time before SMUD will be able to respond to any new applications and actual installation could be 12 to 18 months.

In Conclusion

Can rural America learn something from SMUD example? There are significant differences between SMUD and rural cooperatives. SMUD serves 1.2 million customers in a 900 square mile service area in the Sacramento California metropolitan area. A rural distribution cooperative can serve 900 square miles but usually does not have 1.2 million customers. For the SMUD example to work cooperatives must do what they always do when presented an opportunity larger than any one of them, they organize. Those that are affiliated with a G&T have a natural group already in place. Those unaffiliated may join the GT as a PV member. I am sure other options can be developed. RUS for its part would need to develop a long term outlook as well. Approving a long term PV program and construction work plans incorporating residential PV installations as routine construction items, for example. A 10 year outlook seems reasonable. RUS has already set up renewable energy as an eligible purpose for its Deferred Principal program along with the Energy Resource Conservation program.

By the late 1980's the use of PV by electric utilities was being talked about routinely, with some, such as Pacific Gas and Electric, investigating PV installations because they could postpone construction projects. The greatest benefit to utilities was when PV could be installed at a location where it offset load growth that required capital equipment upgrades, such as increasing line capacity or substation capacity. Further, the greatest benefit is realized when the growing load is relatively small and the cost of the upgrade is fairly large--a situation seen in most rural electric cooperatives. Long lines with small loads represent the best cost savings for to rural electric cooperatives. These lines are where PV makes sense first.

The time to begin to develop PV as a power supply, distribution and rural development option is here. A graduated approach similar to the SMUD example just may work for rural America to get costs down.

Photovoltaics

Has its time come?

Photovoltaics

- Simplicity
- Most efficient during peak demand
- Produces energy under reduced light
- Costs are decreasing

Photovoltaics

- Combustion turbines
  versus
- Photovoltaics
  - Both provide energy at peak demand
  - CT are cheap and fueled by natural gas
  - PV are not cheap and fueled at no cost

Utility Photovoltaics Advantages

- Energy produced reliably at system peak with no control costs.
- Reduced transmission and constraint costs
- Distribution safety
- Existing interconnection guidelines
- Deferred distribution investments
- Distribution system voltage support
- Reduce distribution system losses at peak

Photovoltaic minuses

- Cost of capacity
- Existing approach to valuation.

Solutions

- SODC
  (Sustained Orderly Development and Commercialization)
- DoE/RUS planning/business tools
  – reliability database
  – output database
- Possible listing of PV systems

Photovoltaics

*shade
* emergency
power
for
Fuel pumping
Water pumping
Communications